SUPPORT FOR THE AMENDMENTS

This Amendment amends Claims 1, 20 and 21 by changing "polyvinylidine fluoride" to --polyvinylidene fluoride--. No new matter would be introduced by entry of these amendments.

Upon entry of these amendments, Claims 1-3 and 5-14, 17 and 19-21 will be pending in this application. Claims 1 and 8 are independent.

REMARKS

Applicants respectfully request entry of the foregoing and reexamination and reconsideration of the application, as amended, in light of the remarks that follow.

Applicants thank the Examiner for the courtesies extended to their representative during the July 7, 2003, personal interview. As discussed at the interview, the present invention provides a light, compact and thin battery having a positive and a negative electrode firmly joined together by an adhesive resin layer, which secures both electron insulation and ion conduction between the electrodes and decreases resistance between electrodes, i.e., internal resistance of the battery, to improve battery characteristics.

Independent Claim 1 recites "the adhesive resin comprises a polymer selected from the group consisting of polyvinylidene fluoride and polyvinyl alcohol". The Office Action at page 2, lines 10-16, asserts:

> The claims recite an adhesive resin of "polyvinylidene fluoride", which is interpreted as a fluorocarbon resin containing a polyvinylidene fluoride structure. See specification page 14, 2nd paragraph. Furthermore, "polyvinyl alcohol" is interpreted as a polymer containing polyvinyl alcohol in the molecular structure. See specification page 14, 2nd paragraph. The specification describes both "polyvinylidene fluoride" and "polyvinyl alcohol" as generic terms describing polymers containing a polyvinylidene fluoride structure or a polyvinyl alcohol structure, respectively.

However, the specification at page 14, 2nd paragraph, lines 7-11, states, in relevant part, that:

> In lithium ion secondary batteries containing an organic electrolyte, fluorocarbon resins ***represented by polyvinylidene fluoride (PVDF)*** and polymers containing polyvinyl alcohol in the molecular structure thereof, ***represented by polyvinyl alcohol***, are preferred. (Emphasis added.)

Because the specification at page 14, 2nd paragraph, merely discloses "polyvinylidene fluoride" as an example of a fluorocarbon resin and "polyvinyl alcohol" as an example of polymers containing polyvinyl alcohol in the molecular structure thereof, the specification does not redefine the terms "polyvinylidene fluoride" and "polyvinyl alcohol" away from their conventional meanings. Instead, contrary to the Office Action assertion, the specification and claims use the terms "polyvinylidene fluoride" and "polyvinyl alcohol" as these terms are employed by the skilled artisan. The skilled artisan knows that "polyvinylidene fluoride" has the structure $\{CH_2CF_2\}_n$ and that polyvinyl alcohol has the structure $\{CH_2CHOH\}_n$. See, e.g., Polymer Handbook, pages 51 and 387, copies attached.

Claims 1-3, 5-7, 9, 14, 17 and 19-21 are rejected under 35 U.S.C. § 102(e)/103(a) over U.S. Patent No. 5,948,464 ("Delnick") as evidenced by U.S. Patent No. 6,096,456 ("Takeuchi"). Claims 10-13 are rejected under 35 U.S.C. § 103(a) over Delnick as evidenced by Takeuchi in view of U.S. Patent No. 6,287,720 ("Yamashita").

Delnick discloses an electrochemical cell comprising a cathode electrode and an anode electrode separated by a porous composite separator layer comprising a solid particulate material and a polymer binder. The separator can be formed by printing on one of the electrodes an ink containing the solid particulate material and the polymer binder. Delnick discloses that typical binders include polyvinylidine fluoride-hexafluoropropylene copolymer.

Contrary to conventional terminology, Delnick designates his polyvinylidine fluoride-hexafluoropropylene copolymer as being "PVDF". See, Delnick at column 4, line 38; column 7, lines 12-15; column 10, lines 2-4; column 11, lines 31-32. In particular, Delnick discloses at column 7, lines 5-15, that:

> It is understood by those skilled in the art, that the polymeric binder may consist of a single polymer, a mixture of polymers, or a mixture of polymers and copolymers. Monomers may be included in the ink formulation which are subsequently polymerized after printing the separator. Polymers of the ink formulation may be crosslinked chemically or by appropriate radiation subsequent to printing the separator. Typical binders that may be used for these purposes consist of: polyvinyl chloride (PVC), **polyvinylidene fluoride-hexafluoropropylene copolymer (PVDF)**, and ethylene propylene hexadiene monomer (EPDM). (Emphasis added.)

However, Delnick's "PVDF" (i.e., polyvinylidine fluoride-hexafluoropropylene copolymer) is not the polymer "polyvinylidene fluoride". Polyvinylidene fluoride polymer and polyvinylidine fluoride-hexafluoropropylene copolymer are different compounds with different characteristics. See, e.g., Textbook of Polymer Science, Second Edition, pages 428-429, copy attached.

Because Delnick is silent about the polymer "polyvinylidene fluoride", Delnick fails to suggest the independent Claim 1 limitation that "the adhesive resin comprises a polymer selected from the group consisting of polyvinylidene fluoride and polyvinyl alcohol".

Delnick at column 7, lines 24-27, discloses "a ratio of polymer binder to solid particulate matter ranging from about 5/95 to 35/65". However, Delnick does not disclose what kind of ratio the ratio is (weight, volume, etc.). Thus, Delnick fails to suggest the independent Claim 1 limitation that "a *weight ratio* of the adhesive resin to the filler is not less than 1/5 and not more than 2".

Any *prima facie* case of obviousness based on the cited prior art is rebutted by the

significant improvement in adhesive layer peel strength "in a range of from 50 gf/cm to 85 gf/cm" that is achieved in accordance with the invention of independent Claim 1 when "a weight ratio of the adhesive resin to the filler is not less than 1/5 and not more than 2" and "the adhesive resin comprises a polymer selected from the group consisting of polyvinylidine fluoride and polyvinyl alcohol". Table A and FIG. A from the Amendment After Final Rejection filed December 12, 2002, are reproduced below comparing inventive examples with a comparative example and Yamashita's examples.

TABLE A

	Filler	Resin	Weight ratio (filler:resin)	Particle Size of Filler (μm)	Peel Strength (gf/cm)
Example 17	PMMA	PVDF	1:2	0.5	80
Example 6	alumina	PVDF	1:2	0.01	85
Example 1	alumina	PVDF	1:1	0.01	70
Example 3	alumina	PVDF	1:1	0.1	60
Example 4	alumina	PVDF	1:1	1	65
Example 8	alumina	PVDF	1:1	0.01	70
Example 9	alumina	PVDF	1:1	0.01	70
Example 10	alumina	PVDF	1:1	0.01	70
Example 11	alumina	PVDF	1:1	0.01	60
Example 12	alumina	PVDF	1:1	0.01	70
Example 13	silica	PVDF	1:1	0.01	50
Example 2	alumina	PVA	5:2	0.01	70
Example 14	silicon carbide	PVDF	3:1	0.5	80
Example 15	boron carbide	PVDF	3:1	0.5	80
Example 16	silicon nitride	PVDF	3:1	0.5	80
Example 7	alumina	PVDF	5:1	0.01	60
Comparative Example 5	alumina	PVDF	10:1	0.01	20
Yamashita's Examples 2 and 4-7	alumina, zeolite or aramide	PVDF	20:1	alumina: 1.0 (otherwise silent)	?

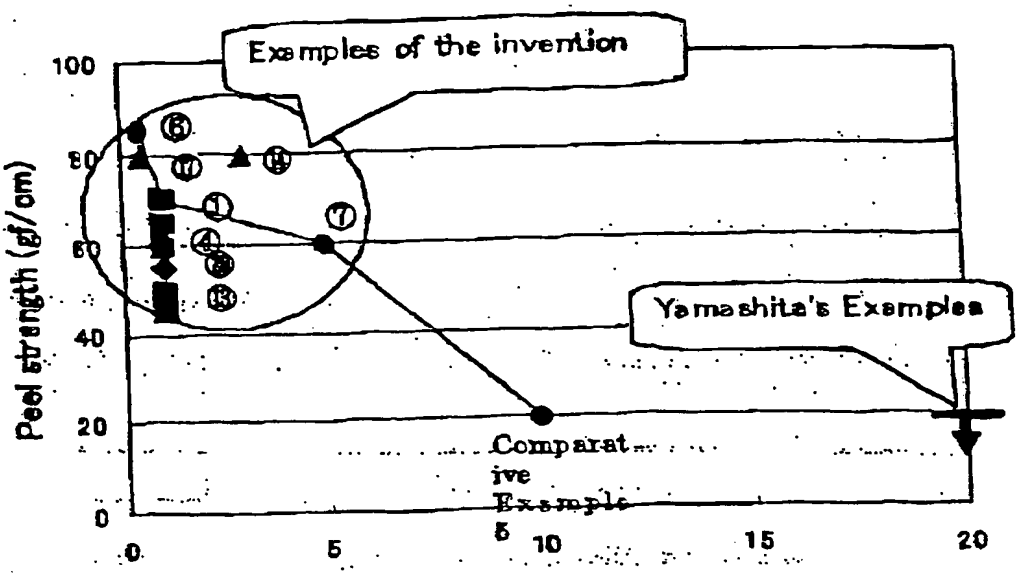

FIG. A: Comparison of peel strength

The cited prior art fails to suggest the significant improvement in adhesive layer peel strength shown in Table A and FIG. A. The Office Action admits that "Delnick is silent regarding ... a peel strength in a range of from 50 gf/cm to 85 gf/cm". Office Action at page 4, lines 10-11. Furthermore, as discussed above, Delnick is silent about polyvinylidene fluoride.

Because the cited prior art fails to suggest the significant improvement in adhesive layer peel strength "in a range of from 50 gf/cm to 85 gf/cm" that is achieved in accordance with the invention of independent Claim 1 when "a weight ratio of the adhesive resin to the filler is not less than 1/5 and not more than 2" and "the adhesive resin comprises a polymer selected from the group consisting of polyvinylidine fluoride and polyvinyl alcohol", any *prima facie* case of obviousness based on the cited prior art is rebutted. Thus, the cited prior art fails to have rendered obvious the claimed invention.

Claims 1, 20 and 21 are objected to. To obviate the objection, "polyvinylidine fluoride" is replaced with --polyvinylidene fluoride--.

Pursuant to M.P.E.P. §821.04, after independent product Claim 1 is allowed, Applicants respectfully request examination of method Claim 14, which includes all of the limitations of product Claim 1.

Applicants thank the Examiner for the indication that Claim 8 is allowed. Office Action at page 7, line 19.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

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Attachments:

Polymer Handbook, pages 51 and 387
Textbook of Polymer Science, Second Edition, pages 428-429

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